Background: Cocaine is a widely abused drug. On \(^{1}\)H MRS, abstinent cocaine users show increased creatine and myo-inositol concentrations compared to controls, suggesting gliosis in the frontal and temporoparietal brain regions (1, 2). PET and SPECT found reduced regional cerebral blood flow (rCBF) and glucose consumption in the cortex and deep gray matter of cocaine users (3, 4). This indicates that cocaine use causes persistent cerebral abnormalities.

Objective: To evaluate and compare rCBF abnormalities on perfusion MRI (pMRI) and on SPECT in asymptomatic abstinent cocaine users.

Design and Methods: 25 abstinent cocaine users and 15 healthy control subjects without a history of drug use were examined with pMRI (using dynamic bolus-tracking), and SPECT (using \(^{133}\)Xe-calibrated \(^{99m}\)Tc-HMPAO). After coregistration (5, 6), the relative rCBF (from perfusion MRI and SPECT) was determined in 20 regions of interest. The data were analyzed with 4-way ANOVA of mixed design

MRI data were acquired on a 1.5T GE scanner. The high-resolution reference scan was a fast spin echo IR sequence (TI/TE/TR=120/32/4000ms, 3.5 mm slices). A single-slice gradient echo sequence was used for pMRI (TE/TR 19/38ms, flip angle 10°, 64 phase encoding steps, time resolution 2.5 sec).

Results: There was a statistically significant interaction between drug use and brain region, indicating differential effects of cocaine abuse on the various brain regions, on SPECT alone, and on SPECT and pMRI combined, but not on pMRI alone. However, there was no interaction among drug status, brain region, and imaging method. Compared to controls, cocaine users showed increased rCBF in the frontal and temporoparietal white matter and in the globus pallidus (see Figure), and decreased rCBF in the putamen and the temporal cortex (SPECT only).

Discussion: SPECT and pMRI detected a regional pattern of rCBF abnormalities in cocaine users that is consistent across the two methods; however, SPECT appears to have higher sensitivity than pMRI (with gradient echoes) in detecting rCBF abnormalities in abstinent cocaine users. The larger variability on gradient-echo pMRI, due to its sensitivity to blood flow in large vessels, may have contributed to the lower sensitivity of pMRI (7, 8). Future studies will determine whether spin-echo pMRI is more sensitive for detecting rCBF abnormalities in cocaine users.

The hypoperfusion in the cortex and deep gray matter of the cocaine users is consistent with previous results suggesting brain injury (1-4). Because astrocytes have higher energy demands than neurons (9, 10), activated glial cells may require even larger increases in glucose utilization and in the tightly coupled rCBF (11). In vitro studies also show persistently increased metabolic rates in astroglial cell cultures after 2 months of chronic cocaine exposure (12). Therefore, the increased rCBF in the white matter of cocaine users may be due to presence of reactive gliosis.

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References: